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ABSTRACT

Based on a series of six field experiments conducted from 1978 through 1981 at Northeast Louisiana University's Sandel Library, this report examines user preferences related to library carrel arrangement in the context of personal space theory. A brief review of research on personal space requirements and a description of Sandel Library and its users precede a composite plan of the library's third floor, which was the location for the field experiments. The various study phases described include experiments with carrels in free-standing, sheltered, partially sheltered, wall-facing, and double row positions and data collection on pattern preference by sex of user. It was found that carrel pattern and position exert significant effects on carrel use and that females and males display significant differences in preference for particular carrel arrangements. The proxemic model of human behavior proposed by Edward T. Hall was used to develop a 4-point model of average user preference. Diagrams and photographs of carrel patterns are presented throughout the report, as well as tables of data on the advantages, disadvantages, and user preference for each carrel arrangement and diagrams showing personal space zones in relation to carrel positioning. Six references are listed. (Author/ESR)

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PERSONAL SPACE AND USER PREFERENCE FOR PATTERNS OF CARREL ARRANGEMENT IN AN ACADEMIC LIBRARY

by

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and

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IR010370

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Personal Space and User Preference for Patterns of Carrel Arrangement in an Academic Library.

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ABSTRACT

In attempting to better serve the users of Sandel Library, the authors created several patterns of carrel arrangements in 1977. User preference for the various patterns in differing environmental situations was studied in a series of experiments from 1978 through 1981. The methodology was that of a field experiment, e.g., the patterns were emplaced, a familiarization period was allowed, and use of the patterns was determined by floor mapping. In the first experiment, four freestanding patterns were rotated among four similar positions. Both pattern and position were found to exert significant effects on use. Four follow up studies examined the same and other patterns in different situations. Results were not as clear cut in sheltered and semisheltered positions. The last study in the Fall of 1981 concerned user distribution among patterns by sex. Males constituted 67.9% of the user population and were evenly distributed in the environment, but females displayed some significant differences in preference. These apparently relate to sexual differences in perception of personal space invasion which have been demonstrated by other researchers.

Personal space theory is employed to explain the findings of the study. Specifically, the proxemic model of human behavior proposed by Edward T. Hall appears to provide a general predictive model of user preference for the various patterns.

This study was presented in a poster session at the Convention of the American Library Association held in Philadelphia. July, 1982.

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PERSONAL SPACE

Each person carries with him an invisible, culturally defined zone, or territory, of a size varying situationally, into which he permits intrusion by other persons only reluctantly. This is referred to as "personal space," or the "body buffer zone." Many behavioral ramifications of this usually unconscious motivation have been explored experimentally.

Much of the research on personal space has been performed in libraries. Dr. Robert Sommer, the foremost expert on the topic, has written several papers detailing his research on how students distribute themselves spatially in the library and campus environment while studying. Within the library environment, he delineated the effect of a single user in various positions at a six person table and various tactics used to defend personal space at such tables. (Sommer, 1966) Others have shown sex differences in response to frontal and side invasions of personal space. (e.g., Fisher, 1975) Specifically, females view a lateral invasion by a stranger as more threatening than a frontal one, while, for males, the converse is the case.

Human traffic was pointed out by Sommer as the most distracting element in a user evaluation of a large reading room, however, about half of the library users preferred open, gregarious areas in which to study. (Sommer, 1966) The same author found that carrel users were more concerned about privacy and seclusion than were the table users. Carrel users were less interested in proximity to materials than in protection from visual distraction. (Sommer, 1968) He states that privacy should be provided for those who seek it, but,

> "The ideal library would not be one with all individual study rooms or all open areas but, instead, would contain a diversity of spaces that would meet the needs of introverts and extroverts, lone studiers and group studiers, browsers and day-long researchers. It is a serious mistake to assume that all people have the same spatial needs."

Another writer on the topic, which he calls "Proxemics," is Edward T. Hall, an anthropologist. Hall writes from a cross cultural viewpoint and has defined several spatial zones about a person. (Hall, 1966) These zones are summarized below:

1. Intimate distance. Less than 18 inches. When another person is this close, discomfort is usually experienced by the average American, unless the other is a "close friend" or loved one.

2. Personal distance. The close phase, one and a half feet to two and a half feet, may be occupied by a man's wife but not another woman. The far phase, up to four feet, is the characteristic distance maintained in most situations by Americans when discussing matters of personal involvement. It is at arm's length, or the "limit of physical domination." Breath and body odors, or body warmth, are normally not detectible at this distance.

3. Social distance. From four to twelve feet is the usual distance for discussions of impersonal business or formal matters. The far phase, greater than seven feet, can act as an "insulator" allowing persons to work in the same space without appearing to be rude. Hall points out that secretaries are often vulnerable in small offices in that "If the receptionist is less than ten feet from another person, even a stranger, she will be sufficiently involved to be virtually compelled to converse."

4. Public distance. This zone is not one commonly encountered in the library setting.

In connection with these zones, it should be noted that Sommer has called attention to the role of visual blocking and/or the creation of distinct territorial boundaries in shrinking the size of the acceptable area. The smaller area may not be as comfortable, but within it the library user can function satisfactorily.

STATEMENT OF THE PROBLEM

In arranging furniture prior to the opening of the third floor addition to Sandel Library in 1977, the authors attempted to arrange groups of carrels in ways other than the traditional side by side pattern. The side by side situation has for several years seemed uncomfortable to both authors and informal observations made it appear to be inefficiently utilized. That is, readers would space themselves out rather than sit side by side for reasons that are rather obvious to those familiar with the personal space concept.

Following Sommer's call for diversity, the purpose of the experimentation was not to choose one pattern of arrangement but, rather, to assess the advantages and disadvantages of several in order to best serve the greatest number of users. Privacy is of concern to most carrel users, thus, the study concentrated on the best provision of individual seclusion through arrangement of the facilities.

Frequently the concern of the library manager is achieving the greatest density of users in the smallest space. However, as Kilgour has stated, "As soon as users are considered as part of library systems, it is clear that user costs are system costs." (Kilgour, 1967) We would not expect our staff members to be effective in the same situations that too often we provide for our users. Thus, by providing facilities that are more effective for the users we can expect more efficient utilization of those facilities.

The carrels employed in this study are the full sided type which provide good individual privacy. The dimensions of the carrels are shown in Exhibit I and on front cover.

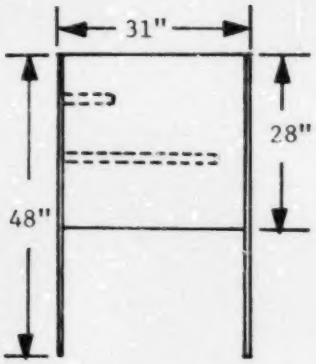


Exhibit I. Lateral dimensions of carrel

THE SETTING

During the period of the studies reported here, Northeast Louisiana University has experienced a growth in enrollment from 8,900 in Fall 1978 to 11,400 in Fall 1981. As there are cultural differences in perception of personal space the following information may be of interest. The majority of students are from Louisiana, particularly the predominantly protestant northern portions, Arkansas and Mississippi. Less than 2 percent are foreign students. Twenty percent were minority members at the time of Phase I; this increased to 23 percent by Phase III.

Sandel Library, a two story building, was opened in 1963. In 1977 a third floor addition was completed. With the third floor, the library was reorganized with Reference, Government Publications and most services on the first floor; Monographs on second; and Serials, Microforms and Special Collections on third.

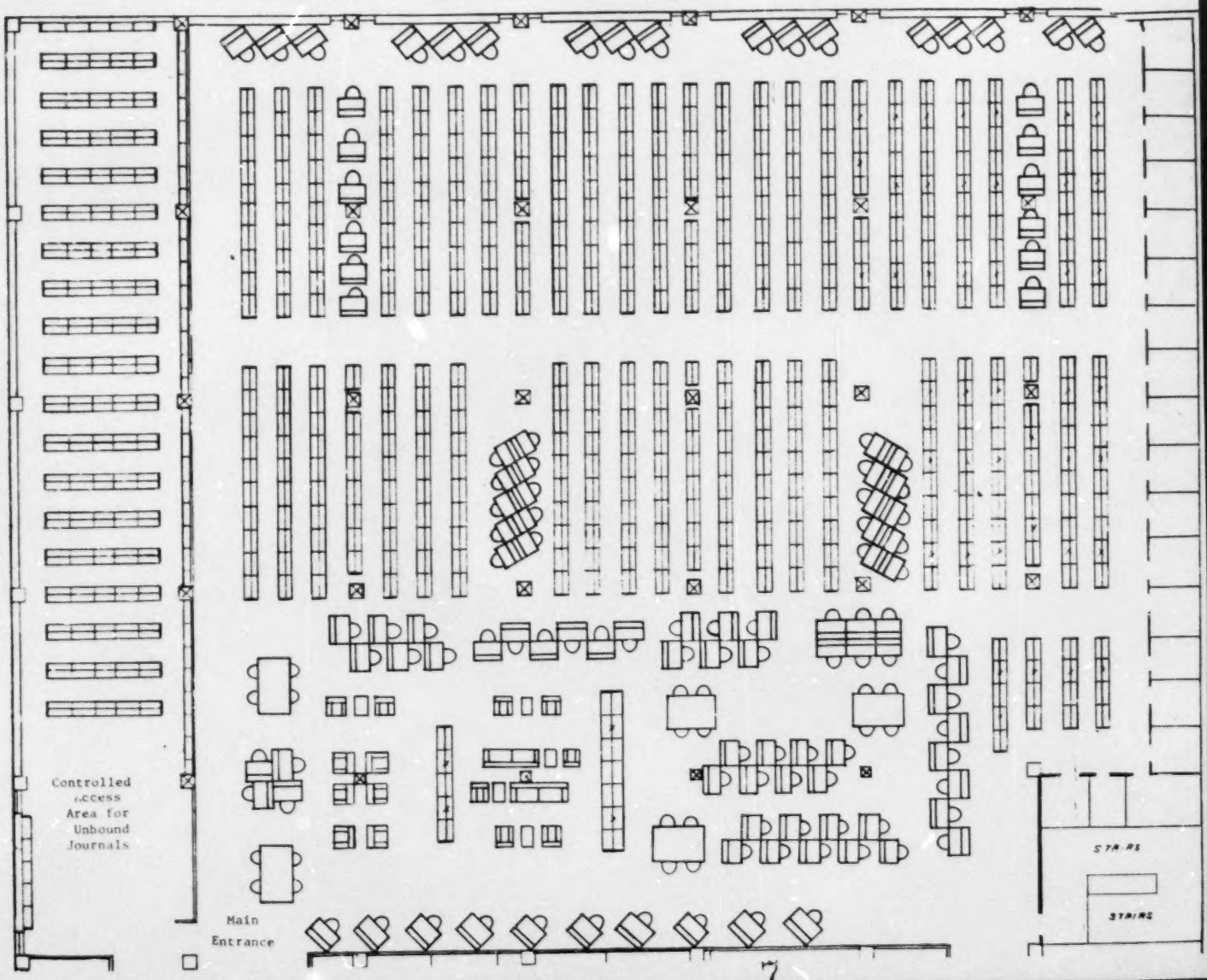
The third floor open serials stacks and reading area was the experimental site. This area was chosen because of the type of carrels. The older floors do not have the same equipment. The second floor has primarily tables and some open carrels, first floor has few reader stations.

The site is 15,000 square feet in size and houses ca. 75,000 volumes of serial publications. The browsing shelf displays popular titles; other unbound issues are located in a controlled access area.

A floor plan for that portion of third floor which was used as the experimental site appears as Exhibit II.

Sandel Library's attendance as measured by an exit counter has increased from 345,521 in 1977/78 to 482,788 in 1980/81. Early indications in the Fall of 1981/82 are that the increase is continuing. Although the increase is certainly the result of a variety of factors, including longer hours, the staff like to feel that it is in part due to the library being a pleasant, friendly place. Studies such as this one and other attempts to satisfy user needs by environmental programming appear to be having an effect.

Exhibit II. Experimental Site, Third Floor of Sandel Library
This is a composite floor plan; at no time was floor arranged exactly as shown.



EXPERIMENTAL GOALS

Factors which were hypothesized as influencing the user's choice of carrel are as follows:

1. The pattern of arrangement. The pattern creates differing degrees of protection of personal space involving proximity to others, potential for eye contact and setting of clear boundaries on territory.

2. The position within the site or cost of use. The assumption in this case is that the principle of least effort influences choice of seat in one of two ways: (a) the user will choose a seat near to, or visible from, the entrance; (b) the user will sit near the source of the materials that he is using.

3. The environment of the carrel group. Lighting, temperature, and other measurable variables are assumed to have been constant for the floor. In this case, the concern is for perceived privacy or seclusion. Contributing variables are visual blockage, and proximity to major aisles and traffic. This factor is in opposition to the principle of least effort as it implies seeking out of a comfortable situation by the user. Four types of environment were investigated:

   A. Free standing, with aisles on both sides of the carrel pattern.

   B. Semi-sheltered, for example, a pattern of carrels near book stacks.*

   C. Sheltered, i.e., between book stacks.*

   D. Against a wall.

4. Sex of the user. As sex related differences in response to frontal and side invasions of personal space have been demonstrated, it was felt that there might be concomitant preferences for carrel patterns.

The study was performed in three phases, the goals of which were:

Phase I, Test the effect on usage of carrel (a) patterns and (b) positions within one type of environment.

Phase II, Test the effect of pattern on usage within an additional four environments.

Phase III, Test for pattern preference by sex of user.

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*Use of the term "sheltered" is, of course, a subjective determination. Each position used in the experiments is to some extent sheltered. It is applied here to those positions that are clearly describable as sheltered due to proximity to book stacks.

EXPERIMENTAL SYSTEM

TACTICS and TIME FRAME.

This study was conducted as a field experiment, that is, no controls were exercised on factors other than those being studied in an effort to avoid bias of the free choice of the users. All data gathering was performed as unobtrusively as possible.

In phase I, February-April of 1978, four patterns of carrels consisting of six reader stations each were rotated among four positions in a free-standing environment.

Phase II began in October, 1978. In this phase four studies were undertaken each involving changing the carrel patterns within one environment. The environments were (1) sheltered; (2) partially sheltered; (3) wall; and (4) double row, free standing. The fourth study was completed in December, 1980.

In phase III, no patterns were changed during the experiment, but distribution of users was studied by carrel pattern and sex of the users. This last study was undertaken in November, 1981.

PATTERNS

The patterns evaluated included the traditional one of side-by-side/back-to-back and others that attempted to improve the personal space considerations. All met the design criteria that they should be infinitely expandable. This resulted in basically linear arrangements.

The patterns are shown in diagrammatic form in Figure 1. Photos of four of the patterns appear as Figures 2-5. Nicknames were given to the patterns to facilitate communication. The pattern designated "Saguro" bears some resemblance to the cactus of that name when viewed in outline from overhead. The related "Gamma" pattern is a serial form of the gammadion, or swastika--the form commonly referred to as "carrousel." The "Hubert" was so-called because it appears in outline as three "H" figures side by side. The source of "offset" and the others are fairly obvious.

METHODS

In phase I four patterns were evaluated in each of four positions within a free standing environment. Following a rotation of patterns, a time lapse was allowed after the installation and the beginning of observations in order to permit the novelty of the new arrangement to be dissipated to some extent. This period was 2-3 weeks: variations were related to allowances for holidays.

Staff members and some student workers in the Serials Unit, which is responsible for the third floor, performed the mapping. Observations were made at random times within the morning, afternoon and evening on four days at each stage. That is, a total of twelve observations were taken during each stage. One floor plan was used for each day's observations, color

coding indicating time of day. All seated users were marked on the floor plan at the position occupied. Moving persons, or those at book shelves, were marked at approximate locations. Users who were just occupying or just vacating a seat were marked as though seated.

In phase II and phase III the same procedures were followed with the exceptions noted below.

In the study of the free-standing, double row situation, only three patterns were evaluated in one environment and all observations were made in morning and afternoon hours. As time of day exerted no detectable effect in previous trials, the night observations were eliminated. In addition, the stages were lengthened to three weeks and twenty four observations were made during each stage.

In all phases the entire floor was mapped so that comparisons could be made with consideration of the size of the floor population. This is a recognition of the fact that the numbers of persons choosing an experimental pattern is a function of the number of persons who are at the site. These floor population totals were used to adjust the statistical analyses.

The possibility of multiple observations of the same patron in different time periods during one stage violates the assumption of independence for the statistical tests. To control this factor would have required us to violate the field experiment conditions and, possibly, bias the results in that manner. That the preexistent dispersion of users will influence the choice of station for the entering patron is basic to the personal space theory. In this light, each use of a reader station could be considered as independent of prior uses by the same patron. The observers seldom reported seeing the same patrons while mapping. Also, careful examination of the data indicates that if the same patrons were observed several times, it is unlikely that they were seated at the identical carrel each time. For these reasons we assume that any violations of the independence of observations would have minimal effect.

FIGURE I

Patterns of Carrel Arrangement

Excluding Wall Patterns

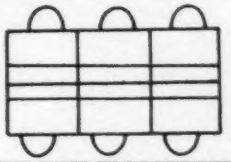
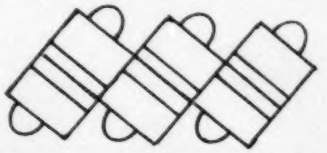
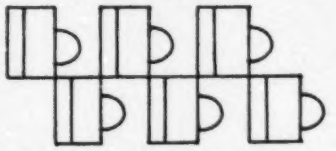
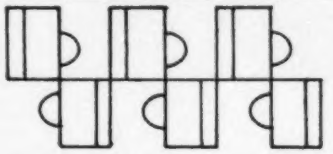
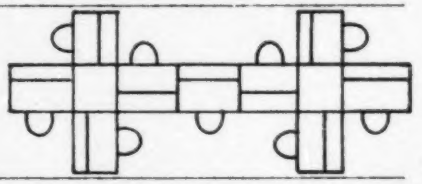
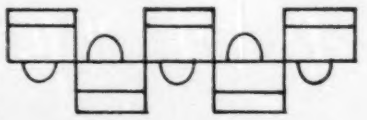
NICKNAME	PATTERN
Hubert	
Angled Hubert	
Saguaro	
Gamma	
Extended Carrousel	
Offset	
Half-Offset	

FIGURE 2 .
View of Patterns in Phase I, Saguaro in Position 1, and Browsing Shelves.

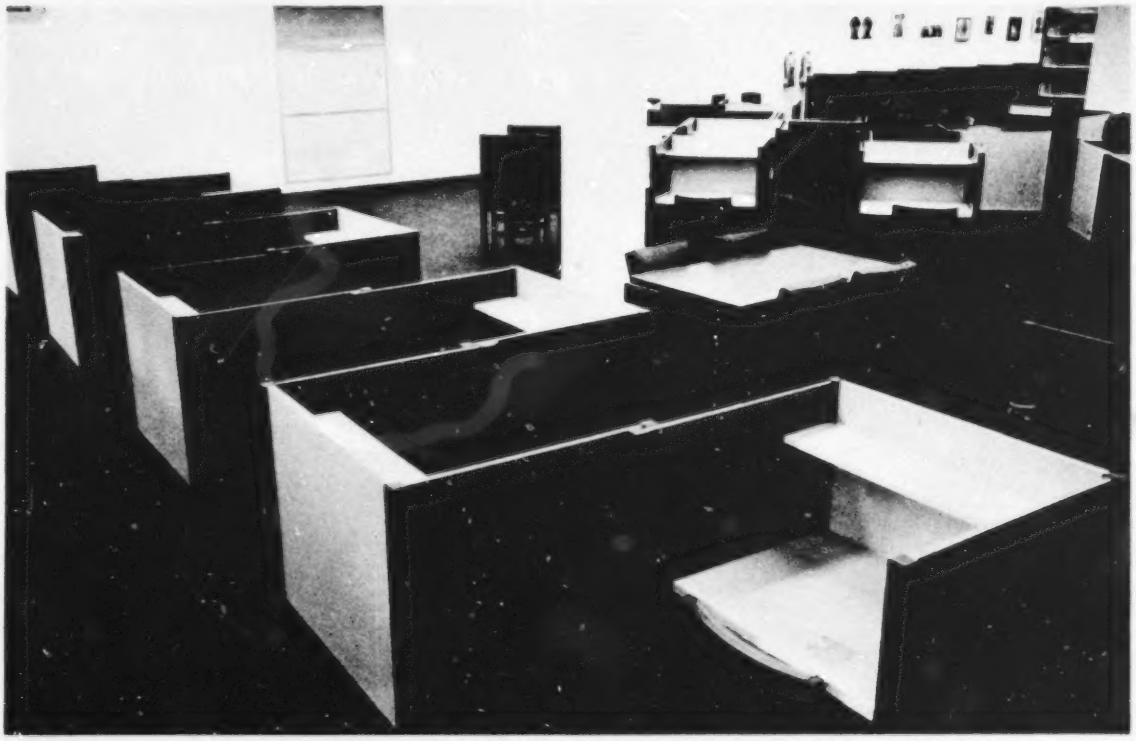


FIGURE 3
Full Offset Pattern at Rear of Room, Oversize Stacks Out of View at Left.

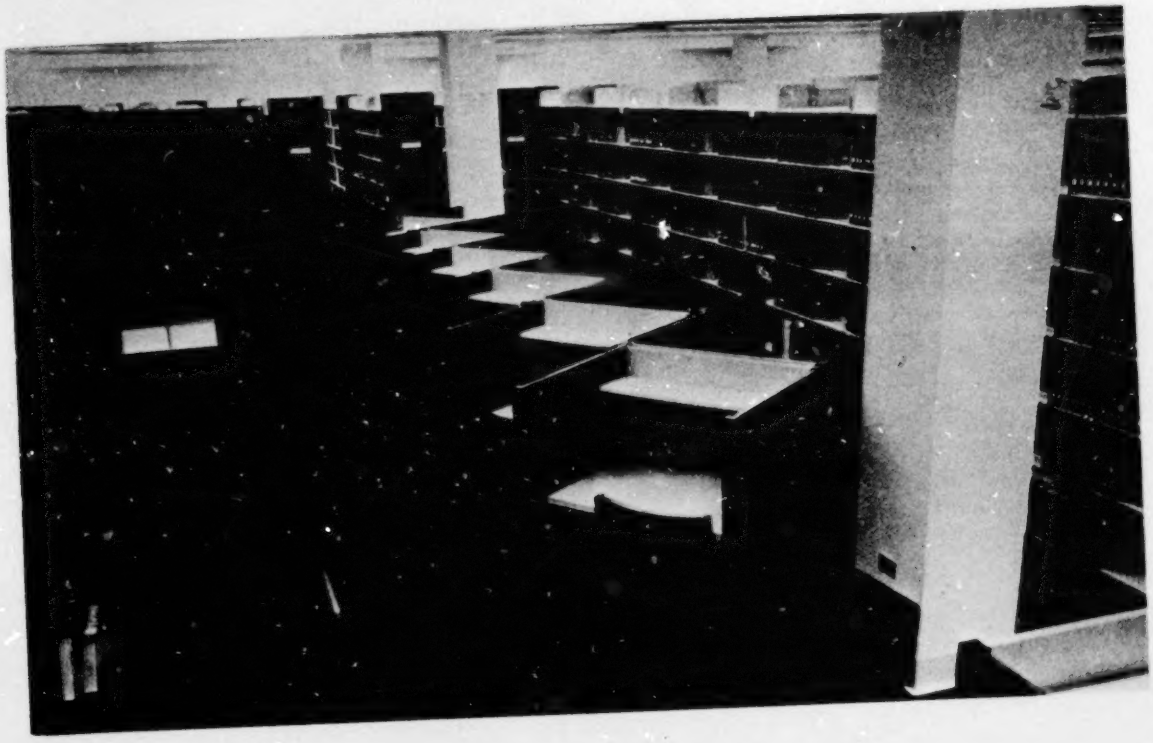


FIGURE 4
An Angled Hubert in a Sheltered Situation.

FIGURE 5
An Angled Arrangement on the Front Wall.

RESULTS

Phase I

The four carrel groups studied in phase I are those shown in the floor plan running in a straight line from the front to the back of the site, bordering on the stack area.

The observed use of the four experimental patterns in phase I is summarized in Table 1. This data was converted to proportions of the total population observed on the third floor during the observation periods then multiplied by 100, and a two way analysis of variance was performed using the SPSS statistical programs. The results are shown in Table 2. Both position and pattern apparently exerted an influence on the users' choice of reader station within the experimental groupings.

The saguaro was clearly the most popular pattern and the second position the most attractive placement. The browsing shelves near position two generated a need for readily available seating which was not completely satisfied by the lounge furniture. The least popular was the traditional Hubert pattern; even in the second position its usage was near the mean of all observations.

TABLE I

Summary of Observed Use in Phase I by Pattern and Position

	Pattern				
Position	Saguaro	Offset	Gamma	Hubert	Total
1	16	12	8	10	46
2	18	10	14	8	50
3	11	9	9	8	37
4	8	2	8	2	20
Total	53	33	39	28	153

The data for both experimental and non-experimental patterns was examined for any effect of time of day (morning, afternoon, night) but no important differences were detected in use of either pattern or position.

Usage of the four experimental patterns averaged 11.5 percent of the total floor population. This ranged from 10.9 to 12 percent during the four trials.

It would be noted that rarely, if ever, during the experimental period of phase I would the third floor have been considered crowded. The percentage of utilization of available seating ranged from 6 to 30 percent. For this reason, the user entering the area was presented with a reasonably free choice of seat. This should result in an effective evaluation of preferences for seat type and location. One exception to this needs to be pointed out, however; there are only 5 study tables on the third floor. This is a limitation for groups of two or more persons wishing to study together.

TABLE 2

Analysis of Variance: PHASE I

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Main Effects	20.852	6	3.475	25.828	0.000
Location	12.535	3	4.178	31.053	0.000
Pattern	8.317	3	2.772	20.604	0.000
Explained	20.852	6	3.475	25.828	0.000
Residual	1.211	9	0.135		
TOTAL	22.063	15	1.471		

In phase I, a strong effect was noticed. Use of the offset pattern of nine carrels near the oversize shelves was primarily on the side near the shelves. Specifically, 35 users occupied the side which left their backs exposed to the shelves, while only 8 were observed on the unsheltered side with their backs to the relatively open area in the center of the room. This preference for the "gunfighter's position" has been noted occasionally in the literature. This was the first environment tested during phase II.

Phase II

The oversize shelves are the four short ranges shown on the floor plan near the rear stairs. In the position near the oversize shelves, a semi-sheltered environment, the patterns tested were (1) offset; (2) 1/2 offset, i.e., the carrels were not fully offset from each other; (3) saguaro; and (4) a double, linked carrousel. The observations are summarized in Table 3.

The half-offset and saguaro were most popular. A chi-square test was performed on the data in Table 3 with the expected frequencies computed as:

$$e_i = \frac{p_i}{P} (N)$$

where p_i = the observed population at the site during period i
P = the sum of the p_i's
N = the sum of observations in the experimental patterns

This is equivalent to flat distribution but is adjusted for the number of users in the experimental site during the observations from which the users of the carrel patterns were drawn. The result of the test was a probability of circa 70 percent which was not significant.

However, analysis of usage by sides of the patterns presented a more clear cut choice of which pattern was best suited for this environment. The most even distribution of users by sides occurred with the saguaro where only 60 percent of the users sat in sheltered seats, although a close runner up was the somewhat less popular extended carrousel with 61 percent on the sheltered side. The saguaro was continued in this position.

TABLE 3

Usage of Patterns in Semi-Sheltered Position: PHASE II

Pattern	Usage	Percentage of Population	Back Sheltered	Back Exposed	Total Population
Offset	11	5.2	7	4	213
Saguaro	20	7.4	12	8	270
Half Offset	21	7.8	16	5	270
Ext. Carrousel	18	6.5	11	7	278

The next study was of patterns of carrels arranged along the wall. Included were: (1) angled with seated user's back toward incoming traffic; (2) angled with back away from traffic; (3) head in to the wall, side by side, i.e., a "half-Hubert," and (4) side to the wall. Both 3 and 4 may be considered traditional. The latter was utilized first on the back outside wall and problems immediately became apparent: users of these carrels began to write on the wall. Accordingly, this pattern was not tested on the front wall, but rather pattern (5), a spaced out, head in to the wall arrangement, was used in that position. Data is shown in Table 4 as as share of total population. Chi-square tests were performed on tallies of users for each of these positions as previously described. In neither case were the results significant (p = ca. 0.50).

In this case, the decision of which pattern to use was based on criteria other than user preference. With sides to the wall, graffiti writers plied their trade; with head in arrangements, the long legged users scuffed the walls with shoe marks. The angled patterns were thus preferable. On the front wall, a spaced out angled pattern was used with gaps between carrels of about half the carrel width. On the back wall, groups of three were angled to the wall between windows.

TABLE 4

Percentage of Population at Site Occupying Wall Arrangements by Position and Patterns (indicated by Numbers.)

Pattern	1	2	3	4	5
Back Wall	19.6	20.5	15.9	19.6	n.a
Front Wall	5.6	7.5	4.3	n.a.	7.4
TOTAL	25.2	28.0	20.2	----	----

Conflicting results were obtained when patterns were tested in the two sheltered environments designated stacks 1 and stacks 2. These are the carrel positions located in wide lateral aisles in the first group of ranges. In stacks 1, angled Huberts were less popular than a Hubert or an extended carrousel, but in stacks 2, the same patterns were more popular than an offset and a saguaro. Interpretation is confounded by the experimentor's error in not utilizing the same four patterns in the two positions.

Reviewing the data from phase I, when an angled Hubert was in place in stacks 1 and a Hubert in stacks 2 further confuses the picture for stacks 1 consistently received more use than stacks 2. This is opposed to other parts of phase II with angled Huberts in both positions, for in those cases, stacks 2 received greater use.

The only conclusion that appears warranted is that the situation itself may be the main attraction of the sheltered environment; the pattern effect may be negligible.

The last test of patterns in phase II was on three arrangements of 18 freestanding carrels consisting of two rows each located in the area behind the browsing shelves. The data and results of a chi square test are shown in Table 5. The expected frequencies were computed as before. The result was judged to be significant as the probability of occurrence was between .02 and .01.

TABLE 5

Chi-Square Test on Data for Free-Standing, Two Row Patterns

Pattern	Saguaro	Hubert	Angled Hubert	Totals
Total Population	647	781	844	2,272
E_i	37.91	45.75	49.34	133
Use	51	32	50	133
X^2	4.52	4.13	0.00	8.65
Percentage of Total Population	7.9	4.1	5.9	

In this siutation the angled Hubert exhibited greater appeal to the users than did the traditional square Hubert pattern, although the saguaro was more effective.

Preference for the inside seats versus the outside seats of the two rows was examined with the expectation that the more sheltered, inside aisle positions would be preferred in all three cases. The result was as expected for the Hubert patterns with nearly 60% choosing the inside stations, but for the saguaro and angled Hubert, the picture was reversed with percentages in the low forties on the inner aisle of the grouping.

Phase III

In phase III the use of the carrel patterns was mapped by sex of users for three weeks. A total of 716 users were observed at the site. Of that figure 486, or 67.9 percent, were male. In the carrels were observed 492 users, 68.9 percent male. The carrel usage is shown in Table 6 by environmental type.

Use of the non-carrel seating (tables, lounge furniture) was almost exactly proportional to the breakdown of the total population by sex.

Chi-square tests were performed as before but using the carrel user population only to compute the expected values. Only one test on situations, that on use of the wall groupings, was significant ($p < .01$). The use of these carrels by females was disproportionately higher than their representation in the total population.

TABLE 6

Phase III Results by Carrel Position & Sex of User

CARREL POSITION TYPE	MALE	FEMALE	TOTAL
Sheltered	108	37	145
Percent	74.5	25.5	100
Semi-Sheltered	35	7	42
Percent	83.3	16.7	100
Wall			
Front	19	15	163
Back	74	55	
Percent	57.1	42.9	100
Free Standing	103	39	142
Percent	72.5	27.5	100
TOTAL	339	153	492
PERCENT	68.9	31.1	100

When the data were regrouped by type of carrel another interesting feature emerged. For phase III there were 36 reader stations arranged in Hubert patterns; only eight of these were in the traditional square Hubert, the others were angled. In the sheltered situations, use of these by sex was proportionate to the population make up, but in the free standing situation (24 stations) there were 33 males to only 5 females observed during the study. The expected numbers would be 26 to 13. A chi square test on use of this pattern type by sex of user gave a probability of occurrence of between .02 and .01, which was judged significant. That females avoid the Huberts would seem to confirm the findings of other researchers that females are more likely to view an approach from the side as a territorial invasion. However, the sheltered situation appears to exert an effect negating the sexual differences. Further research is indicated on this aspect.

DISCUSSION

As a whole, the authors found that intuitive predictions of usage of the patterns based on understanding of the personal space theory were reasonably accurate. The greatest discrepancy was between expectations and results in the sheltered situations. But, anyone who takes the time to read the material available on this topic can learn to generally anticipate the use of proposed facilities. Especially recommended are appropriate chapters of Sommer's work, Personal Space, and Hall's, The Hidden Dimension.

In the next section Hall's proxemic zones are fitted onto the patterns tested to provide a more objective predictional model of carrel pattern usage. What follows here are notes about the various patterns.

The saguaro was the most popular pattern in all but the sheltered environments. The disadvantages of this pattern, which it shares with the other nontraditional ones are (1) that when space is at a premium, it will seat only half as many users as the Hubert; and, (2) it makes no allowances for dyads.

The offset pattern may be too confining for many users. There is some indication that the half-offset is preferable, but in any case, this pattern suffers from the exposed back syndrome. Percentage of occupancy is likely to be no better than with a Hubert, and may actually be less in some situations. A door on each carrel might improve utilization by providing the user a sense of back protection; however, this would require longer sides on the carrels.

With regard to wall arrangements, the angled pattern was chosen as our only wall pattern in order to protect the walls. The walls at the site are pure white and easily scuffed or marked. When patterns other than the angled one were tried, such as head in to the wall and side to the wall, the walls were marred by the students propping their feet up and/or by graffiti and smudges. However, there is a segment of the student

population which is apparently uncomfortable with other than right angles: on the rear wall, out of sight of the staff, the carrels are frequently rearranged. (Some of the unofficial changes are obviously to accommodate a group of two or more students who wish to study together, and some of them are to realign relative to a window.)

It should be noted that all of the carrels tend to "wander" inasmuch as each is freestanding and we have not attempted to tie them together in any way. Student workers are required to give frequent attention to realignment of the patterns.

Although the carrousel pattern was not part of the experiments, there were two examples on third floor during phase I and a part of phase II. Use of the one in a semi-sheltered environment was somewhat better than the free standing one, but in both cases it was negligible. This pattern is appealing to those doing floor layouts for its compactness and flexibility in a small open space or around a column. However, if other options are available, students seem to avoid the carrousels.

Recommendations for use of the carrel patterns are summarized in Table 7. Following Sommer's lead, we suggest that planners attempt to provide variety in reader stations with the greatest allowance for personal space that is feasible in the quarters to be furnished.

Nearly all the patterns employed in this study could provide more adequate personal space if the carrel dimensions were increased slightly both in width of the work surface and in length of the lateral walls. The cost of such modifications should be minor if such changes were specified when ordering equipment in quantity, such as at the time of equipping a new building. Another means of reducing the cost of modification is to have the carrels built in patterns rather than grouping individual ones. This would also reduce the problem mentioned earlier of carrels "wandering" and requiring frequent reallignment within the patterns.

The following caveat is offerred regarding the findings of this study: there may be regional differences in preference for the patterns. However, some simple studies of use of the facilities will allow the librarian to make adjustments to best serve the local user population. Note that the rule of changing one variable at a time applies to environmental experiments, as well as others. For example, what happened to the users who didn't like one of the experimental carrel patterns? In the two row, free standing study the saguaro patterns were occupied by 7.9 percent of the floor population while the nearby wall arrangement had 3.7 percent. When the saguaros were replaced by Huberts, the experimental patterns dropped to 4.1 percent of the population, but the wall pattern rose to 4.9 percent. When the angled Huberts were installed, the wall pattern dropped to 3.4 percent and the experimental pattern rose to 5.9 percent. This demonstrates a migration by users from an unpopular pattern to the nearest arrangement that satisfied their needs.

TABLE 7

PATTERN	ADVANTAGES	DISADVANTAGES
Hubert	Compact. Most economical for space. Most appropriate for dyadic seating.	Unpopular, especially with females, if other patterns are available. Acceptable in sheltered situations.
Angled Hubert	More popular than square Hubert and nearly as compact. Works well in sheltered situations.	Unpopular with small segment of males and most females in free standing situations.
Saguaro	Most popular in the free standing situation. Even two-sided utilization	Less compact; requires twice the square footage per user that the Hubert does.
Gamma	No advantages over Saguaro.	Less popular than Saguaro.
Offset	Same numbers of seats in same square footage as Hubert but in different shape space. Attractive appearance.	Probably too confining for many users. Half offset may be preferable.
Extended Carrousel	No advantages were noted.	Not space efficient; may be confusing to users.
Carrousel	Fills odd spaces compactly. Attractive appearance.	Unpopular if other patterns are available.
Side to Wall	Probably the most popular wall arrangement.	Allows graffiti writing and smudging.
Head in to Wall, or half-Hubert	Compact.	Share disadvantages of Huberts and users scuff walls with feet.
Angled to Wall	Improved personal space, especially if carrels are separated. May be slight preference for facing incoming traffic.	Lacks back protection

A PREDICTIVE MODEL

While the third phase experiments were in progress, an attempt was made to use Hall's model of proxemic behavior to arrive at a predictive model of general preference for carrel patterns. As a first step, the zones described by Hall were superimposed on diagrams of the carrel arrangements.

To accomplish this, the proxemic zones were conceived as radiating from a point six inches behind the center of the carrel's work surface edge. This is not an entirely arbitrary decision in that this defines the zones around a point that approximates the user's body center. (The zones are usually considered as extending from the body surfaces.) The intimate zone (18" radius) has a diameter, in this case, the width of the carrel enclosure. The initimate zone would probably shrink to this size due to the physical barriers provided by the lateral walls of the carrel.

The resulting diagrams appear as Exhibit III, A-E.

The three zones plotted are:

1. Intimate zone; radius of 18 inches.
2. Personal zone, close phase; radius of 2 1/2 feet.
3. Personal zone, far phase; radius of 4 feet.

It was soon apparent that the zones were insufficient factors to explain all the observed behavior. For example, the zones are sufficient to explain the preference for the saguaro, with the potential for two other users on the border of the personal zone, as opposed to the Hubert with two persons inside the personal zone. But the zones would not predict the preference for the saguaro over the carrousel* which also has two potential users on the border of the personal zone. Therefore, the factor of back protection was added to the model.

The preferences which were considered experimentally significant were in two sets, listed below in the order of popularity:

Set 1	Set 2
1. Saguaro	1. Saguaro
2. Gamma	2. Angled Hubert
3. Offset	3. Hubert
4. Hubert	

Looking at set one, the saguaro and gamma rankings demonstrate that the factor of one other person within the personal zone is a greater disincentive to use than is having two others on the border of the same zone. The offset and Hubert patterns both have two other persons potentially within the personal zone, so the zone theory is sufficient to explain the gamma's greater popularity among these three.

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*This preference was not experimentally verified but is the result of informal observations as noted in the preceding section.

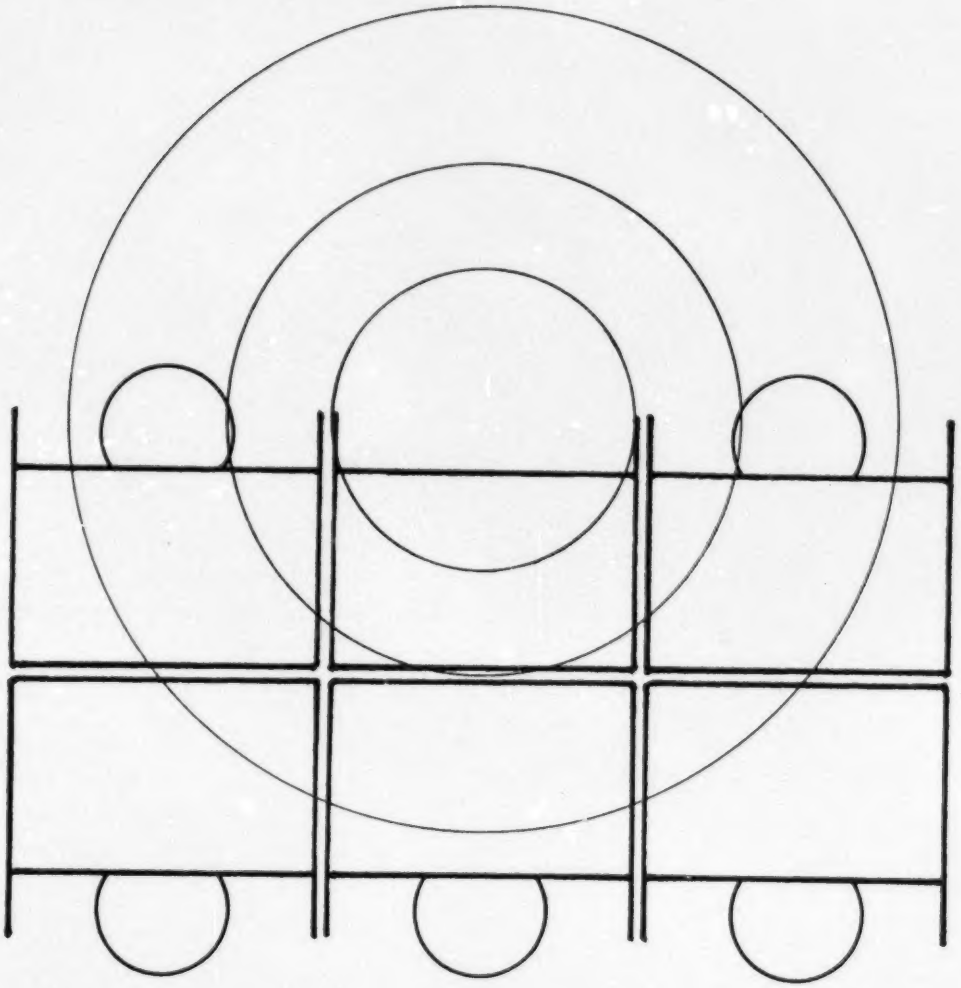


EXHIBIT III A
HUBERT

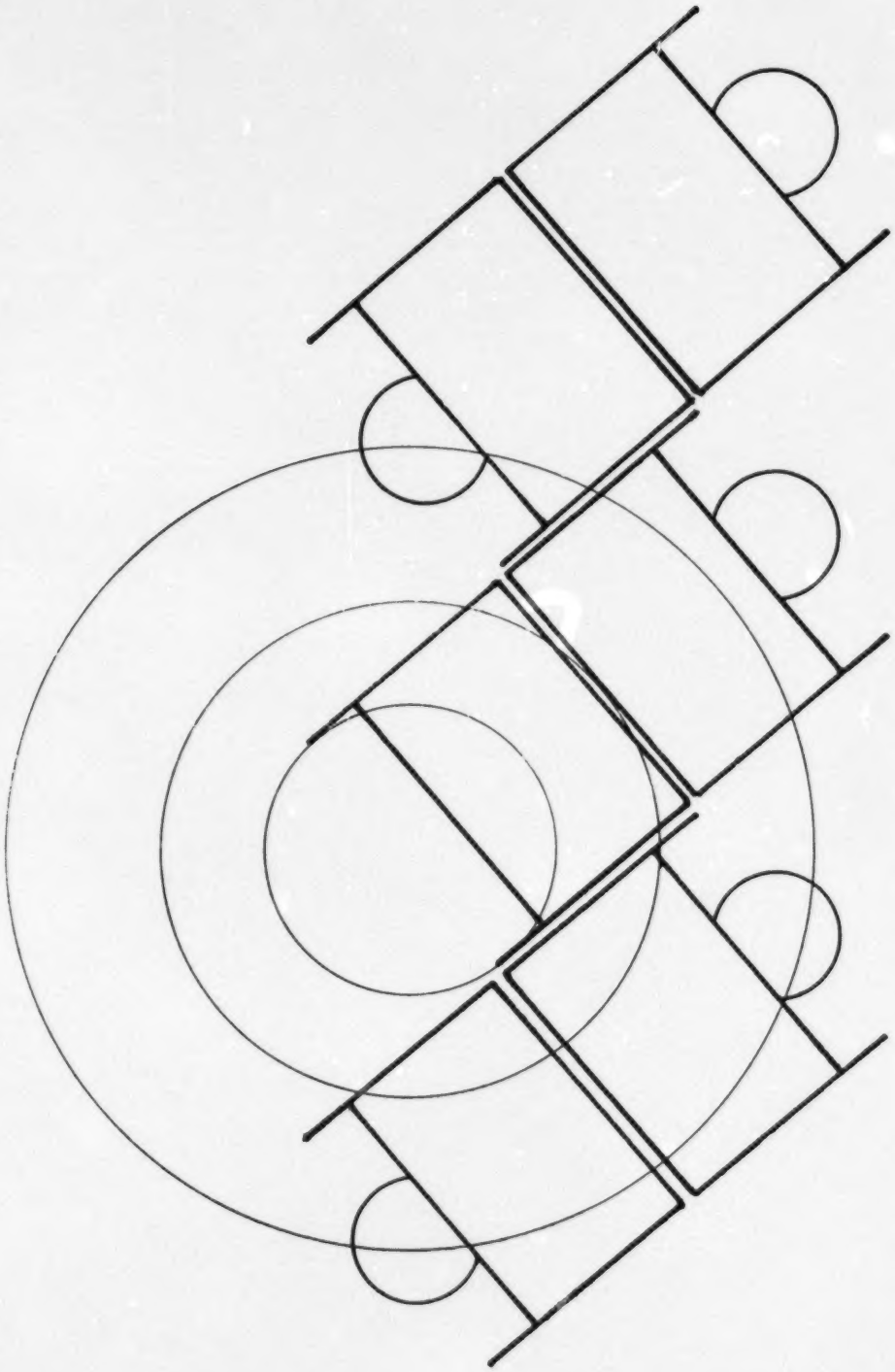
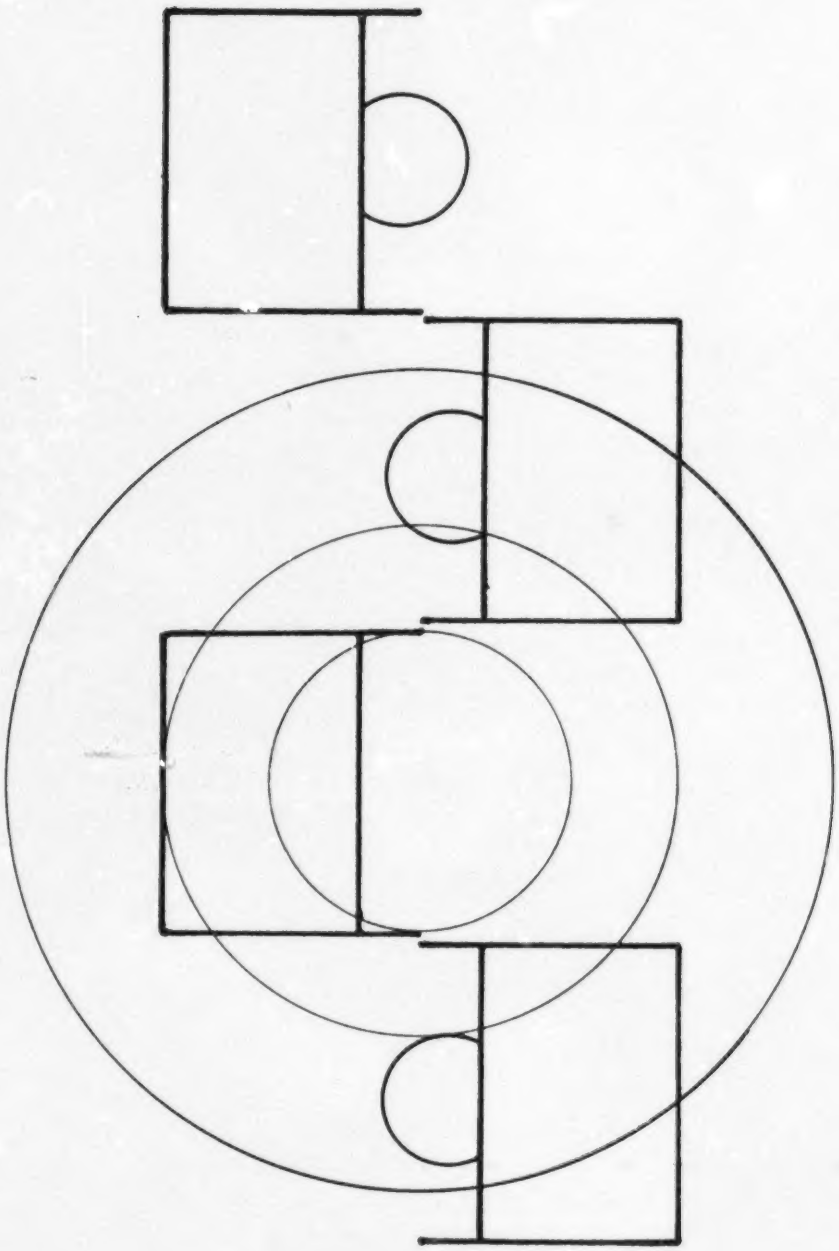


EXHIBIT III B
ANGLED HUBERT



26

EXHIBIT III C

OFFSET

22

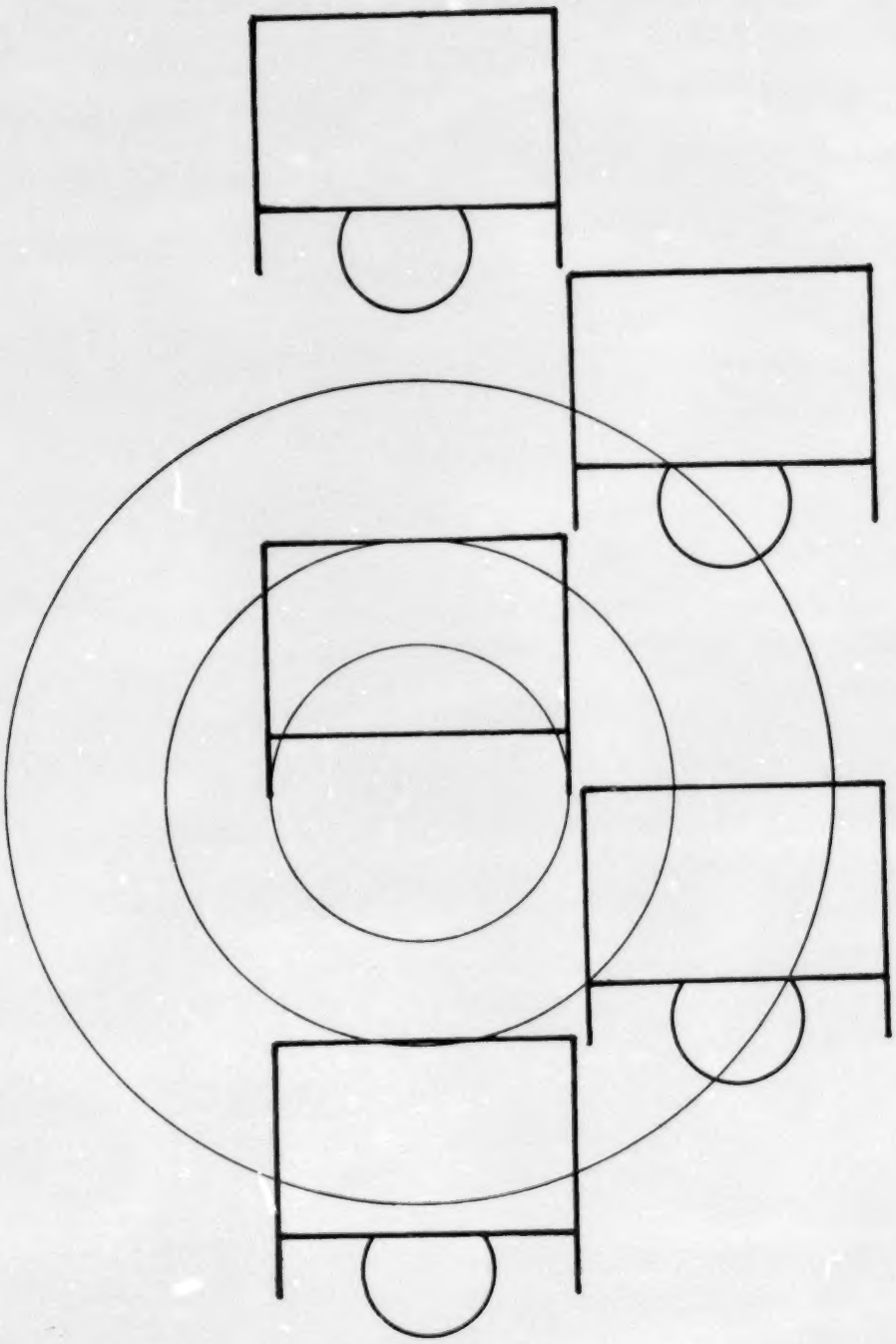


EXHIBIT III D
SAGUARO

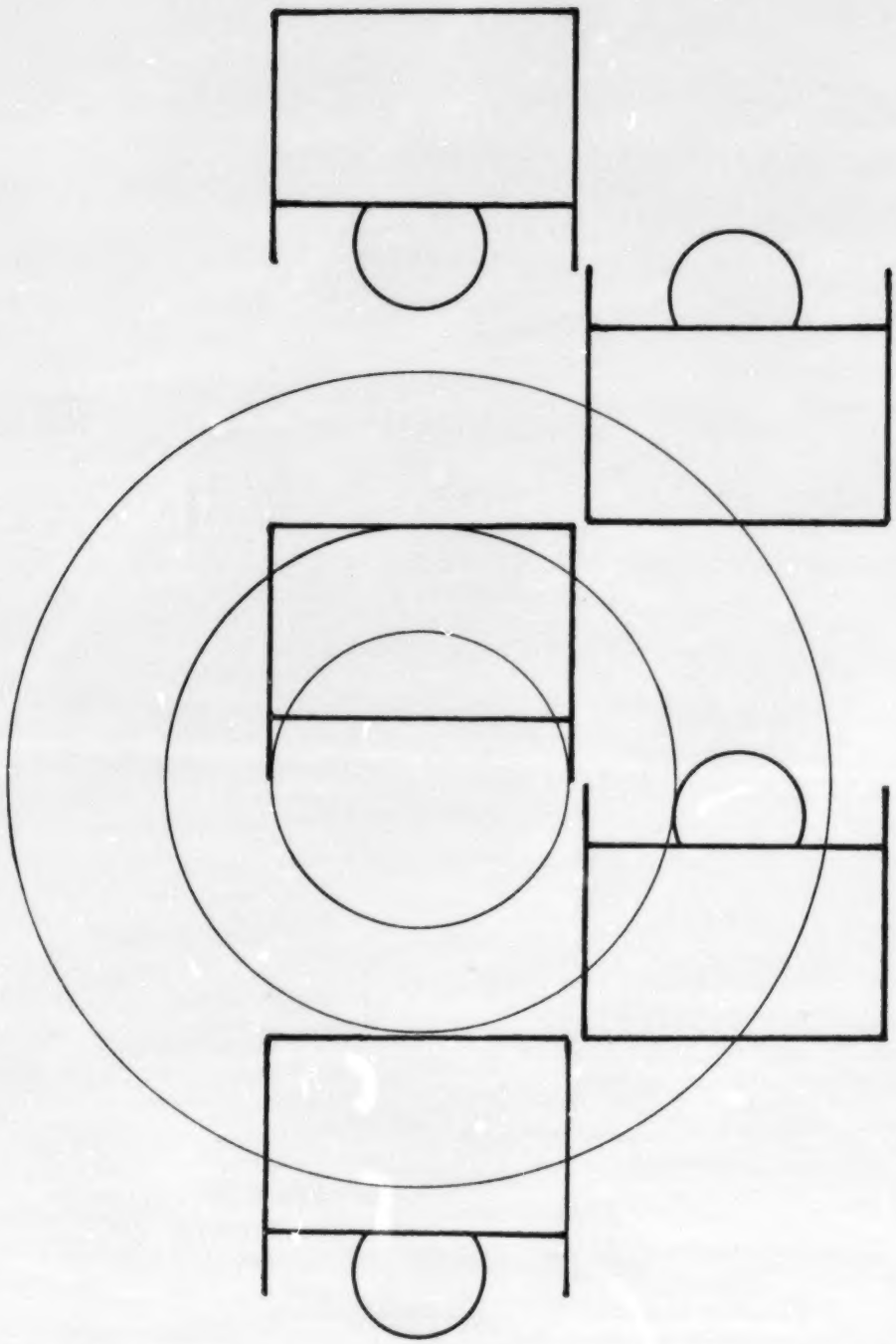


EXHIBIT III E
GAMMA
24

To explain the difference in preference for the offset and Hubert we must add another factor to the model - that of a physical barrier between reader stations.

The second set of verified preferences adds very little to the model. The saguaro has two other stations on the border of the personal zone; the angled Hubert has three in similar positions, the Hubert has two within the personal zone. Thus, the zones are sufficient to explain the observed preferences.

Both sets of significant preferences were obtained in free-standing situations. Therefore, this model is presented only for such placements. The model is stated below with the factors arranged in what is conjectured to be the order of priority.

Tentative Model of Solitary User's Preference for Carrel Patterns in a Free-Standing Situation

The average user will prefer:

1. A carrel which offers back protection.
2. A station with the least number of potential other persons within the personal zone.
3. A station with the least number of potential other persons on the border of the personal zone.
4. The position with the most complete physical barrier between the user and the contiguous stations.

A factor which did not prove necessary to explain the findings, but which might be considered in future research, is that of visual angle of the seated user relative to other stations in the pattern. In the saguaro and the wall patterns, the users all face the same way, i.e., the visual angle is 0°. In the carrousel the angle is 90°; in the other patterns is found a combination of 0° and 180°. Informal observations indicate that usage is inefficient in the patterns with 180° visual angles, that is, the occupancy tends to be one sided or checkerboarded. It is also conjectured that a 180° angle is preferred to a 90° angle; this would account for the unpopularity of the carrousel. However, since the carrousel was not used in the experiments, there is no certain ranking of its popularity with which to make this comparison.

Table 8 lists the carrel patterns and indicates the factors from the model appropriate to each pattern. The visual angle relative to other users is also included. The table lists the patterns in descending order of preference for the average user as predicted by the tentative model.

TABLE 8

PATTERN	BACK PROTECTED	OTHERS IN ZONE	OTHERS ON BORDER	PHYSICAL BARRIER	VISUAL ANGLE
Side-to-wall	Y	0	0	Partial	0°
Saguaro	Y	0	2	Full	0°
Gamma	Y	1	0	Full	0°/180°
Angled-to-Wall	N	0	2*	Partial	0°
Carrousel	N	0	2	Full	90°
Angled Hubert	N	0	3	Partial	0°/180°
Offset	N	2	0	Full	180°/0°
Head-in to Wall	N	2*	0	Partial	0°
Hubert	N	2	0	Partial	0°/180°

*If carrels touch; if gaps between carrels are provided this factor may be reduced to zero.

This model has not been validated. It is based on informal observation and intuitive conjecture as well as the experimental findings of this study, and the work of other writers including Hall and Sommer. It is offerred as a tentative guide to the planner, but, more importantly, as a suggestion for further research.

It should also be noted that the model, if proven, will only predict the preference of the majority of users -- not the preference of all users. Indeed, carrels are not the first choice of many library users as places to study. Sommer found that tables were preferred by about one-half of the students interviewed in his studies. (Sommer, 1966) In order for the planner to serve the total population, a mix of reader stations should be provided within the constraints of space available and number of users to be served.

Acknowledgements

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